

# EXAMPLE

## ABCD-0012 - Autonomous Navigation and Attitude Reference System (ANARS)

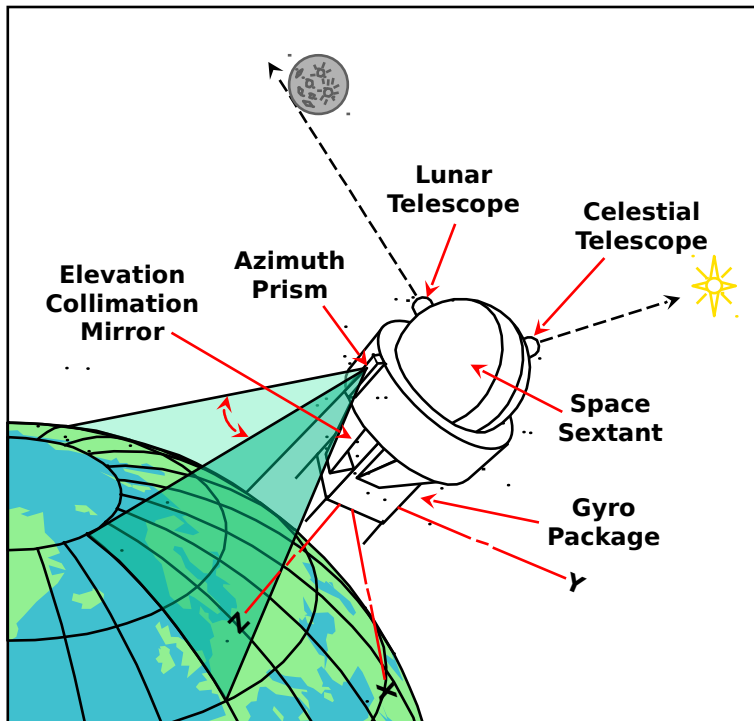
### Concept

**Objective:** Investigate the use of an onboard autonomous spacecraft navigation capability.

- Independent of ground control
- Sustain approximate orbital accuracy of  $\pm 800$  ft
- Emergency back-up operation for primary ground station failure due to catastrophic or hostile action

**Description:** Observes stars and lunar limb offset angles from nadir reference gyro by means of space sextant. Earth azimuth and elevation are optically referenced.

Equipment:



Descriptive Graphic

- |                            |                                |
|----------------------------|--------------------------------|
| • Lunar telescope          | • Gyro package                 |
| • Celestial star telescope | • Elevation collimation mirror |
| • Azimuth prism            | • Space Sextant                |

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### Justification

- **Military Relevance**
  - AFSPC MNS 003-91
  - Supports operational requirements for NPOESS, SBIRS
  - Addresses satellite navigation deficiency identified in AFSPC MAP's
  - Potential applications to existing operational systems such as AWS, DMSP, Future communication systems
  - Technology base new initiative for "Survivable Satellite" ACTD #123
- **Need for Spaceflight**
  - Test for accuracy not achievable on the ground
  - Tracking rates unrealistic if tried from ground/air
  - Required for risk-reduction prior to deployment of first SBIRS in FY03
- **Comparison to Alternatives**
  - ANARS  $\pm 800$  ft and 1 arc sec pointing accuracy
  - GPS more accurate ( $\pm 10$  ft) but does not provide autonomy
  - NASA's SANS program not fully autonomous, less accurate

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### Detailed Overview

- **Flight Data:**

- Free-flyer: 900 ( $\pm$  50) km, Circular orbit,  $>90^\circ$  Inclination
- 1 flight required (12 months duration) to meet objectives
- 1.5 m<sup>3</sup>, 182 kg, nominal 250 W

- **Status:**

- Hardware fabricated; modifications required to gyro package and elevation collimation mirror
- CDR Complete July 2000
- Flight Ready 4Q FY 02

- **Priority:**

- 2000 AF SERB 2/26
- 1999 DoD SERB 5/40

- **Requested STP Services**

- ✓ Launch Services
- ✓ Launch Integration
- ✓ Spacecraft Development
- ✓ Operations
- ✓ Spacecraft/Experiment Integration
- ✓ Data Distribution

- **Funding:**

- Total Cost: \$18.7M
- No out of budget requests/requirement
- Experiment 90% funded through completion

	Prior	FY00	FY01	FY02
FY03				
Req't	\$2.4M	\$3.1M	\$7.2M	\$5.4M
	\$0.6M			
Actual	\$2.4M	\$3.1M	\$6.5M	\$4.8M

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## Summary of Data Application

- The Air Force Research Lab's Space Vehicles Branch and DARPA will utilize the data from this experiment to develop a guidance system which allows two satellites to effect an orbital rendezvous without human input
- This data will ultimately enable formations of satellites to autonomously transfer from a communication mission configuration to a reconnaissance mission configuration
- The data analysis will be complete 18 months after the experiment is launched
- Applicable category of this research is Applied Research

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### Flight Mode Suitability

#### Flight Mode Satisfied

#### % Experiment Objectives

Shuttle	0%
Shuttle Deployable	15%
Shuttle Deployable with Propulsion	40%
International Space Station	25%
“Piggyback” Free-flyer on ELV	80%

***How important is it to retrieve your flight hardware for analysis or reflight? Can you place a dollar value on this? What is it?***

Not necessary for this experiment.